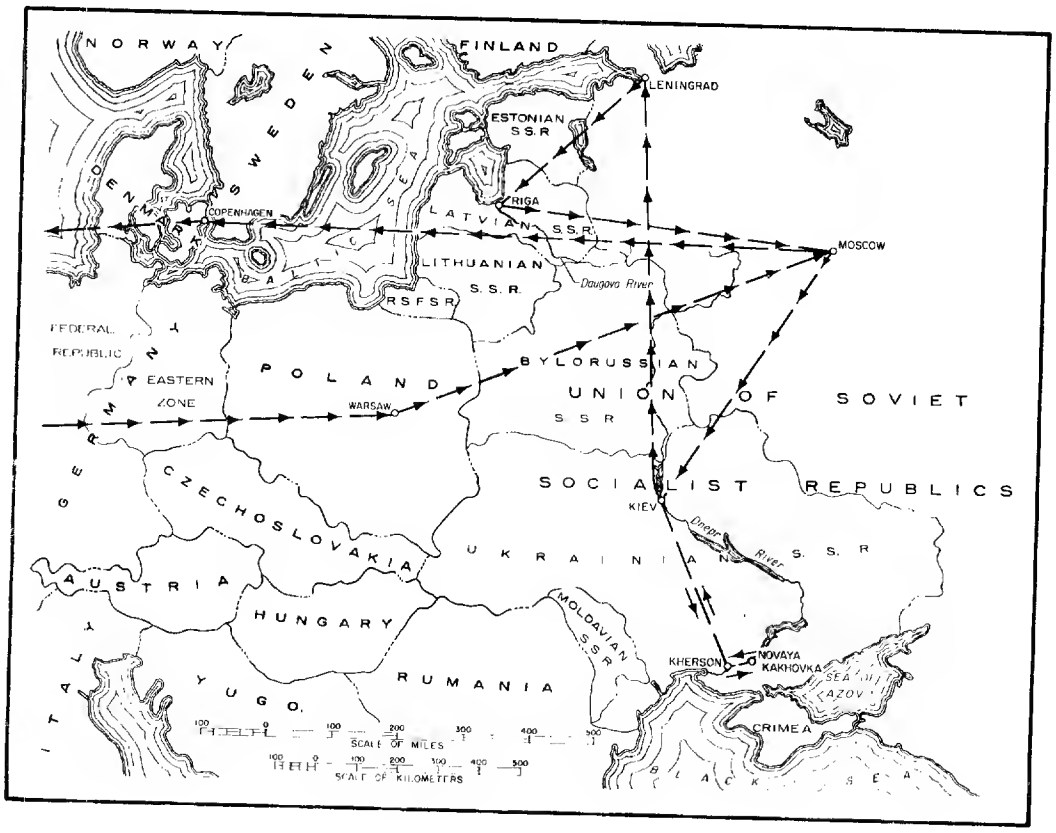
PLASTICS IN HYDROTECHNICAL CONSTRUCTION

Report of the United States Working Group Visit to the Soviet Union September 12-29, 1974.



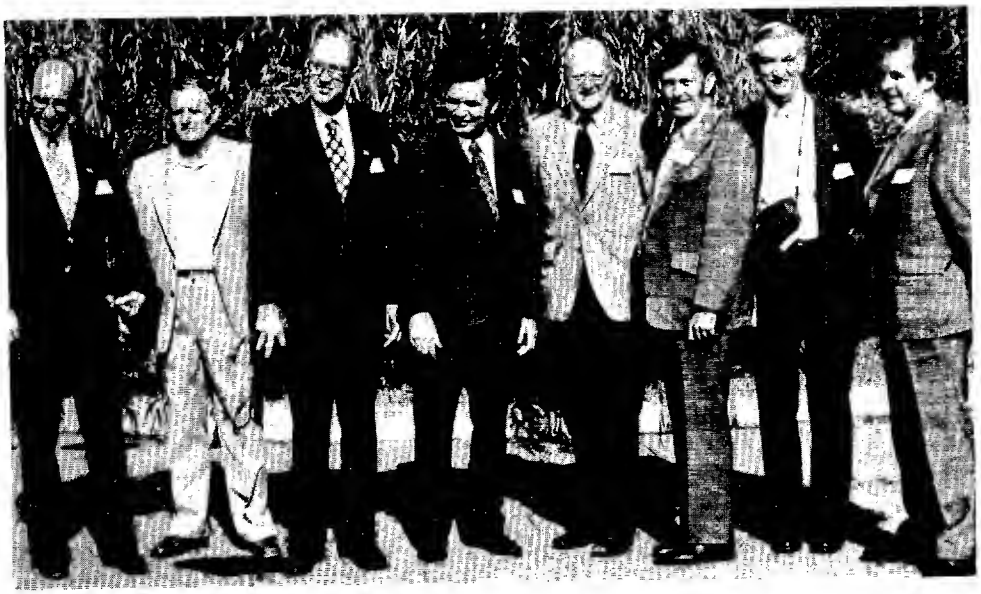
Visit Arranged in Accordance with U.S.-U.S.S.R. Agreement on Cooperation in the Fields of Science and Technology.

State Dept. declassification & release instructions on file

December 1974

DELEGATION MEMBERSHIP

H. G. Arthur	U. S. Coordinator of Project II-3 and Head of Delegation Director of Design and Construction, Bureau of Reclamation
J. P. McGarvey	Technical Director, Film Operations, Arco Polymers, Incorporated
W. J. Ochs	Water Management Engineer for Drainage, Soil Conservation Service
R. E. Philleo	Chief, Concrete Branch, Chief of Engineers, Corps of Engineers
G. N. Thorsky	Chief, Division of Engineering Support, Bureau of Reclamation



Left to right: W. J. Ochs; Soviet representative (unidentified); G. N. Thorsky; A. I. Kharin, Deputy Director, UkrNIIG-M; H. G. Arthur; R. E. Philleo; J. P. McGarvey; P. B. Sviklis, U.S.S.R. Coordinator of Project II-3.

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INTRODUCTION

The visit to the Soviet Union was tentatively arranged in July 1974 when the U.S. Working Group hosted the 3-week visit of the U.S.S.R. Working Group to the United States. The trip to the Soviet Union was, therefore, an exchange visit. It constituted the second meeting of the U.S.-U.S.S.R. Joint Project Group on Plastics in Hydrotechnical Construction.

This Joint Project, designated as Project II-3, is one of four projects established by the U.S.-U.S.S.R. Joint Working Group on Scientific and Technical Cooperation in the Field of Water Resources, which was established under U.S.-U.S.S.R. Agreement on Cooperation in the Fields of Science and Technology, signed May 24, 1972. The technical categories of responsibility of the Joint Working Group on Project II-3 are: plastic film linings for seepage control, plastic pipe for irrigation and drainage, polymer concrete and polymers for stabilizing cut and embankment slopes.

Four members of the U.S. delegation to the U.S.S.R. represented governmental agencies having a major interest in water resources development conservation. One member represented the manufacturing industry of plastic film in the U.S. A sixth member of the U.S. Working Group, Mr. Ray Durazo, Executive Director, Plastics Pipe Institute, was unable to join the delegation because of prior commitments. Mr. A. Rodzianko accompanied the delegation as interpreter.

As U.S. Coordinator of Project II-3, Mr. Arthur has overall responsibility for all programed categories of work agreed upon. Mr. Ochs is subchairman of the group of technical specialists that will eventually be needed to work out the details and implement the program involving plastic irrigation pipe and drainage tubing. Mr. Philleo, who is currently president of the American Concrete Institute, is responsible for Project II-3 work on polymer concrete. Mr. Thorsky is subchairman in the areas of plastic film for seepage control and polymers for stabilizing cut and embankment slopes. Mr. McGarvey is to serve as the contact and coordinator with the plastic film industry; Mr. Durazo is to serve in a similar capacity in the area of plastic pipe, if the proposed plan is consummated.

AREAS VISITED

Moscow

The delegation left Washington on the evening of September 10 and after a 1-day layover in Paris, arrived in Moscow on the afternoon of September 12. Mr. P. Sviklis, U.S.S.R. Coordinator; J. J. Walter, a

member of the U.S.S.R. Working Group; and V. V. Medvedev, Senior Engineer, Department of Scientific and Technical Cooperation with Foreign Countries in the U.S.S.R. Ministry for Land Reclamation and Water Management, met the delegation at the airport and escorted it to the Hotel Rossia.

In the forenoon of September 13, the group visited the U.S.S.R. Ministry for Land Reclamation and Water Management. Mr. I. I. Borodavchenko, Deputy Minister, who is also U.S.S.R. Chairman of the Joint Working Group on Scientific and Technical Cooperation in the Field of Water Resources, welcomed the group to an initial meeting whose Soviet participants are listed in Appendix 2. He described the U.S.S.R. reclamation program in general terms. He explained national plans for adding 850,000 hectares (2,100,000 acres) per year to the irrigated acreage of the Union.

Mr. Borodavchenko invited comments of the U.S. delegation on the proposed itinerary. The proposed itinerary was generally similar to that agreed upon during the Soviet's visit to the United States in July 1974. It was to include visits to construction sites in the Ukraine to observe the installation of plastic film membranes in canals as well as sites near Leningrad, where plastic drainage tubing was understood to be in process of installation. Mr. Arthur requested that, if possible, the itinerary include a visit to a plant manufacturing plastic film. The Soviets said they would try to arrange a visit to a Moscow plant. The actual itinerary is Appendix 1 of this report.

Mr. Sviklis asked Mr. Arthur if the delegation had a proposed program for Project II-3 activities through 1980. Mr. Arthur provided him with two copies of the draft proposals. Mr. Sviklis then advised that Mr. Kharin, who was a member of the Soviet delegation to the United States in July, would join the U.S. group in Kiev. Mr. Vladimir Sedunov was assigned as interpreter in lieu of Mrs. Korbut who had been a member of the Soviet delegation to the United States in July.

In the afternoon of September 13, the group met briefly with Mr. John Ward at the American Embassy. Mr. Ward was acting for Dr. J. L. Tech, Scientific Attache. Mr. Ward reminded us that the May 1972 agreement runs for 5 years, and he suggested that cognizance be taken of this in discussions with the Soviet delegation, if joint program activities are scheduled beyond 1976.

On Saturday, September 14, the group visited the International Exhibition Polymer '74 which was being held in Moscow from September 3 through September 16. Some 500 firms and 19 countries, including the United States, exhibited chemical technology. Among the most impressive exhibitors were Australia, Italy, Germany, and Japan. On Sunday there was a guided tour of the Kremlin and the Armory. The Armory is a museum

(within the Kremlin) of outstanding collections from the time of the Tsars. In the evening, the delegates were guests of the Soviets at a beautiful ballet, Giselle, at the Palace of Congresses, in the Kremlin.

Kiev

On September 16, the group was in travel to Kiev, capitol of the Republic of Ukraine. Mr. A. I. Kharin, Deputy Director of the Ukrainian Scientific and Research Institute for Hydraulic Engineering and Land Reclamation (UkrNIIG-M), met the delegation at the Kiev airport upon its arrival that evening.

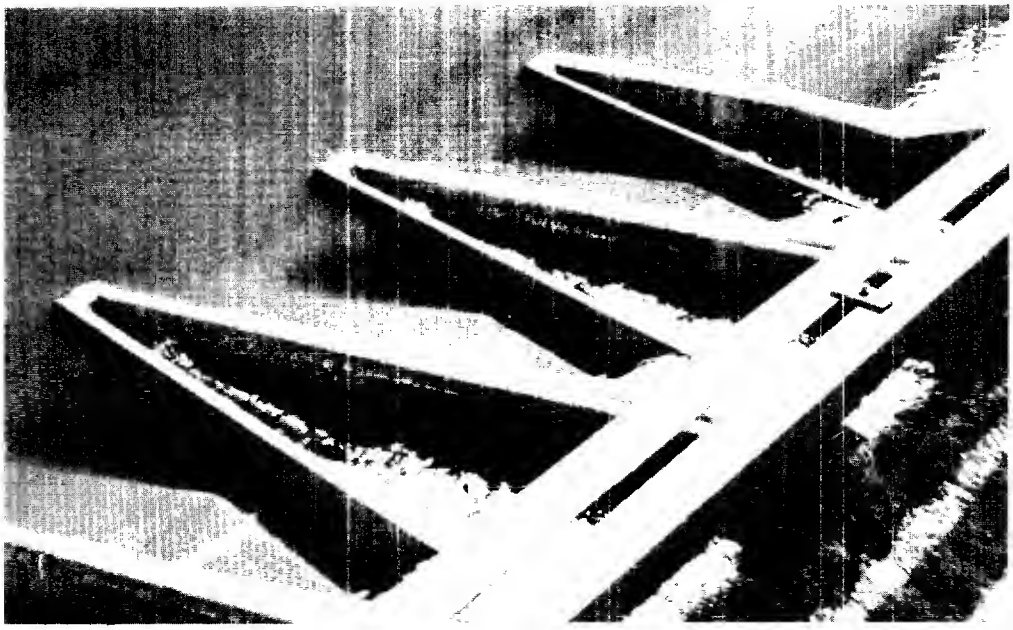
September 17 was spent at the Institute; Mr. Kharin was in charge in the absence of the Director. A list of participants in meetings at the Institute constitutes Appendix 3.

The Ukraine is the well-known "bread basket" of the Soviet Union. There are 1.2 million hectares (3.9 million acres) of irrigated land in the Ukraine and 1.8 million hectares (4.4 million acres) of drained land. In the current 5-year plan (1971-1975), the Union expects to place another 400,000 hectares (1,000,000 acres) under irrigation and add 600,000 hectares (1,500,000 acres) to the drained land in the Ukraine.

UkrNIIG-M serves all land reclamation needs in the Ukraine and the adjacent Republic of Moldavia. It also is the leading Institute in the U.S.S.R. for special studies in irrigation, drainage, development of special machinery, and specialized usages of polymers. The Institute employs about 560 people of whom about 400 are scientists and engineers. The Institute has been in operation since 1929. It currently is studying irrigation scheduling, selection of types of irrigation, new construction materials, combined irrigation and drainage systems, economics of reclamation, and mechanization of construction.

After an initial briefing, the group toured six laboratories in the Institute, the first being the hydraulics laboratory. A flume for the study of siltation/erosion and the development of bed plating applicable to mountain streams, and models of a siphon-type pump discharge outlet and duck-billed weirs were among facilities of the laboratory. Laboratory personnel said they would send to the U.S. delegates the results of their studies on the siphon outlet.

The corrosion laboratory at the Institute is currently studying the protection of metals subjected to a wet environment, and the use of petrochemicals on surfaces to prevent the growth of algae and organisms, such as snails. To prevent such growth, the laboratory recommends use



Model of "duck-billed" weir in UkrNIIG-M laboratory.

of a PVC and Zn or Cu salt solution, for which, it believes a 6- to 7-year performance record may be feasible. The solution is applied at the rate of 230 milliliters/m^2.

The laboratory is investigating the use of a material composed of polyisobutyl bitume and fatty acids derived from petroleum to hold riprap together on slopes.

Laboratory personnel also reported the use of petroleum residues for canal seepage control by mixing the residues into the soil by the following two methods:

1. A chemical solution (possibly kerosene or diesel fuel mixed with fatty acids and polyisobutylene) is introduced into the canal water to achieve a 1 to 2 percent concentration. It is left to stand until, through seepage, the solution is carried into the soil. This method is used for small canals.

2. The method used for reservoirs and large canals follows:

   a. The earth surface is roughened and the solution is sprayed on at a rate of about 0.5 Kg/m^2 (1 lb/yd^2).

   b. The earth is mixed to a depth of 25 to 35 centimeters (10 to 14 inches).

   c. A protective cover of earth, 20 to 30 centimeters (8 to 12 inches) thick, is placed over the surface.

Institute personnel report an effectiveness of about 80 percent in reducing seepage by the latter method at a cost of 20 to 30 kopeks/m^2. They have a 10-year record of experience with the methods. Ponding tests show a decrease in the seepage rate with time. Laboratory technicians attribute the decrease in penetration rate to the fact that the materials are carried progressively deeper into the soil.

Laboratory personnel discussed their work in the use of chemicals to modify soils for increased crop yields. They apply urea formaldahyde resins at a rate of 300 to 500 Kg/hectare (270 to 450 lb/acre). It serves as a nitrogen bearing fertilizer, increases permeability by 40 percent, and facilitates leaching. One application lasts about 5 years and costs 150 rubles per metric ton.

The group then visited the materials laboratory where it was informed as to laboratory experience with polymer concrete, plastic film for seepage control, and sealing of concrete canal lining joints.

Laboratory personnel are familiar with the Bureau of Reclamation's research with polymer-impregnated concrete and acknowledged its advances. They have repeated many Bureau experiments with similar results. They apparently have done considerable work in the area of polymer concrete (wet mix). Furfural acetone resin is the monomer. The test properties that they quoted were all good, including bonding of polymer concrete to steel. Their applications have been in hydraulic structures subject to cavitation and severe abrasion - such as high-velocity flows carrying abrasive sands and gravels. They have found the polymer concrete's resistance to abrasion equal to granite and the cost of furfural acetone resins 8 to 10 times less expensive than epoxy resins. In their practice, polymer concrete is either cast in place or precast. They mentioned one spillway where they had used precast slabs made of furfural acetone resin, 7 percent by weight and aggregate up to 20 millimeters (3/4 inches) in diameter. The furfural acetone costs 55 kopecks/kilo. They expect even better results with a modified furfural acetone resin costing more than one ruble/kilo. They find polymer concrete to be six to seven times more expensive than portland cement concrete. They are looking for alternative, less expensive resins, and new applications, such as precast pipe.

The Soviets are using polyethylene (PE) film extensively in their canals in the Ukraine. In small canals they use a 200-micron (8-mil) thickness under concrete lining (monolithic and precast concrete), and in large canals they cover two layers of 8-mil PE film with about 1 meter of earth. They said plastic film reduces seepage losses from over 1,000 liters/m^2/day to 6 to 8 liters/m^2/day (3.3 ft/ft^2/day to .02 ft/ft^2/day). The latter figure is comparable to losses obtained in the United States in canals with unreinforced concrete having small plastic water stop joints for crack and seepage control.

When they use film under concrete, which is normally precast, they do not seal the joints. They use this construction technique for the more porous soils. For the less permeable soils they use precast lining, without membrane underlay, and seal the joints. Sealants from many European countries have been tested but they perfer a polysulfide manufactured in the Soviet Union. They require a 100 percent stretch after 300 cycles and a 28 lb/in^2 tensile strength of their sealants.

The laboratory for cavitation resistance testing uses a closed test method. An abrasion-resistance test machine in the laboratory uses tumbling cast iron balls. New tests are being investigated to more closely approximate prototype conditions. Experiments on a modified furfural acetone resin paint for lining steel and concrete surfaces subject to abrasion were explained. The product has about the same abrasive resistance as epoxy resin. They also showed a test specimen of two pieces of concrete cemented together with a furfural acetone

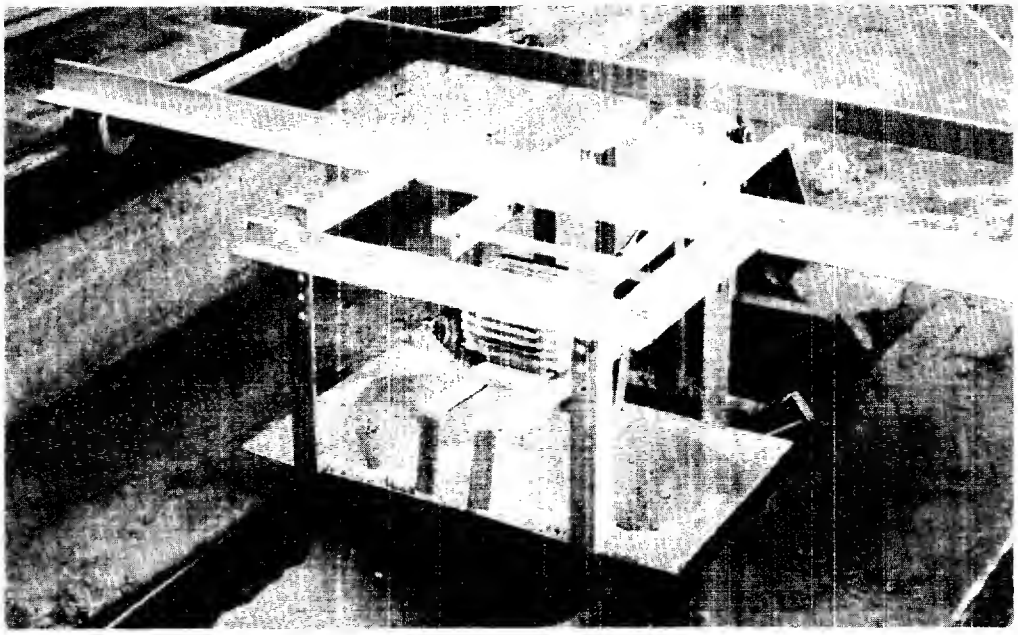
resin glue. A laboratory test was performed wherein the specimen broke outside the glued location.

The chemical laboratory studies properties of furfural acetone polymer concrete and various other formulations of polymer concrete, both the impregnated and wet-mix types. The best aggregates are granite and quartz. The Soviets claim a small amount of graphite, about 1 percent, is a beneficial additive, as it reduces internal friction in the mix.

A laboratory for research on machinery for laying film and placing concrete or sand/gravel cover over the film is part of the Institute complex. The laboratory is developing a machine that is expected to lay and seal polyethylene strips 8 to 10 meters (8.7 to 11 yards) wide. Development was also proceeding on a vertical trenching machine which places a vertical plastic membrane. Models of both machines are in the laboratory. They apparently now have machines that will place membrane liner and monolithic concrete in one operation in small canals. Movies of one such machine in operation on a construction site were shown. The model of the machine that places vertical film curtains utilizes a vertical screw to excavate the trench followed by the placement of the plastic curtain. The laboratory projected slides showing the procedure for lining large canals with PE membrane strips 8 to 13 meters (8.7 to 14 yards) wide placed transversely and thermally sealed. The strips are protected by an earth cover.

The Institute is investigating the use of plastic drainage tubing for both wet and dry climates. It has developed a corrugated PVC tubing which is produced in one continuous narrow strip and then interlocked into tubing of various diameters. Diameter is controlled by the size of drum on which the strip is wound. The winding/interlocking/sizing process must be completed while the extended strip is still warm. The interlocks are not watertight allowing water to infiltrate at the continuous seam on the circumference of the tubing. This makes it unnecessary to cut, saw, punch, or drill holes in the tubing. The tubing is made in diameters of 100 to 150 millimeters (4 to 6 inches). Properly constructed, it will resist damage from virtually any cover. Its filter is a mat made of fiberglass which is wrapped around the tubing. The manufacture of about 200 kilometers of this tubing within 30 kilometers (19 miles) of Kiev is expected next year.

A movie of a unique machine for placing the tubing and filter to a depth of 4 meters with a screw-type trencher/plow was shown to the delegation. The drainage tubing is fed through a rotating screw auger which is hollow. The laying rate of the machine is 30 meters (98 feet) per hour. It will handle rocks up to 10 centimeters (4 inches) in diameter. The machine is undergoing field tests now. They have built two prototypes in cooperation with France. It was first used experimentally in 1970.



Laboratory model of machine placing PE film in canal and covering it with sand - UkrNIIG-M.

Laboratory model of machine excavating trench and placing PE film vertically - UkrNIIG-M.

On September 18, the delegation visited the Ukrainian State Institute for the Design of Water Resources Development Projects. Mr. B. I. Strelets, Chief Engineer of the Institute, welcomed the group and introduced his staff (Appendix 4). Mr. Strelets briefed the delegation on the responsibilities of the Institute in the areas of design and research for irrigation and drainage systems, dams, water-supply systems, flood control, erosion control, and related activities. Their responsibilities include development of standards and guidelines for design and construction.

The Institute is organized into three main divisions: (1) Survey division, which performs preconstruction work such as geologic investigations, soil analyses, topographic mapping, chemical analyses, and collection of design data; (2) Design division which is the largest division; and (3) Research division which is small and only does limited specific research. Major research is done by UkrNIIG-M. Each of the three divisions is further divided into departments with about 50 people each. In addition, the Institute directs field offices. Most people in the Institute are hydraulic engineers, organized principally along project lines. However, there are specialized organizational activities, too, such as people who design pumping plants, and people who design dams. In other words, it is a matrix-type organization. The Institute is composed of 2,500 people, plus affiliates and some small field projects for a total of 5,000 people. Of this number, 35 percent are engineers and scientists.

A staff engineer at the Institute described the features of the Kakhovka and North Crimean Canal systems in the southern steppe region of the Ukraine in advance of the delegates departure from Kiev. The delegation left the Kiev airport at about 3:00 p.m., arriving in Kherson at 4:20 p.m. The delegates were then conveyed by surface transportation to Novaya Kakhovka, arriving there about 6:00 p.m.

Kakhovka

September 19 and 20 were spent in viewing the Kakhovka and Crimean Canal Systems that are an important part of the southern steppe development.

The southern steppe region will eventually have 1-1/2 million hectares under irrigation. The region has an annual precipitation of from 250 to 350 millimeters. Its land is very fertile and slopes gently from north to south. The source of water is the Kakhovka Reservoir on the Dnepr River. Water is lifted from the Reservoir by a pumping plant now under construction. Its capacity will be 530 m^3/s (18,700 ft^3/s) with a lift of 25 meters (82 feet). There will be 16 pumps, 2 each with capacity of 20 m^3/s (715 ft^3/s), 12 pumps each with a capacity of 40 m^3/s (1,430 ft^3/s), plus 2 small pumps. One of the steel discharge lines from the pumping plant was operable at the time of the visitation.

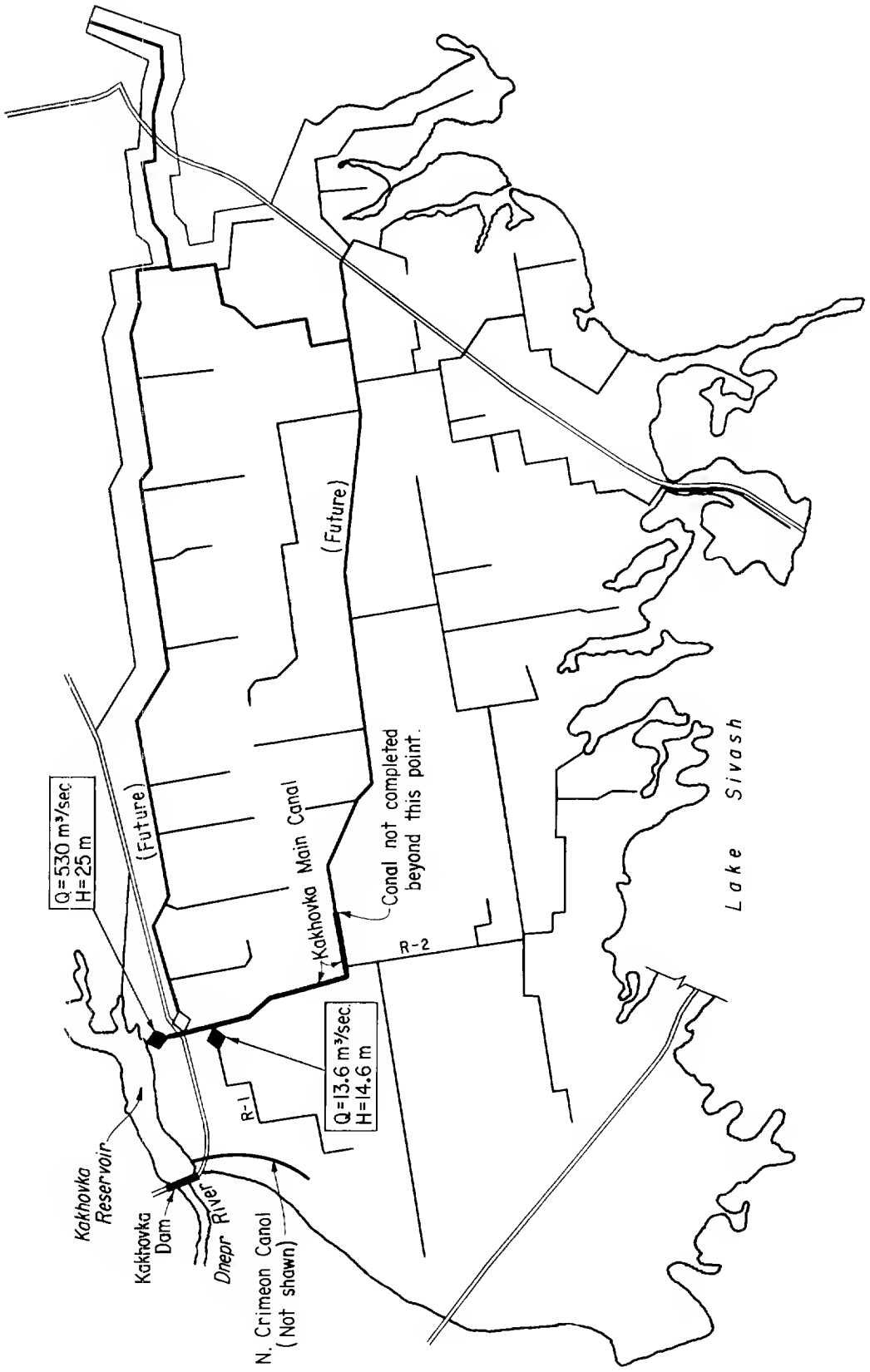
The length of the main canal will be 130 kilometers (81 miles). The laterals to the south will all be fed by gravity and the land to the north of the canal will be fed by pumps with a lift of 15 meters. Construction of the system was started in 1967. The main canal is now under construction and the initial effort will be to supply water to 250,000 hectares (640,000 acres). The canal and pumping plant are being built to serve 1 million hectares (2,500,000 acres). About 280,000 hectares (690,000 acres) in the eastern region is to be supplied water from the main canal.

The initial capacity of the main canal is 530 m^3/s (18,700 ft^3/s). Its cross section is a polygon approaching a parabola in shape. Its depth is 8 meters (26 feet) and it has a top width of 100 meters (328 feet). The whole canal will be underlain with polythelene film. The film will be covered with soil, 1 meter (3.3 feet) thick, for the major length of its wetted perimeter. In the beach zone area the film will be covered with monolithic concrete. Laterals whose capacities are less than 15 m^3/s (550 ft^3/s) will be lined with precast slabs over polythelene film. Water will be pumped to laterals from the canal and each pumping plant will serve about 1,500 hectares (3,700 acres). Collective farms vary from 800 to 2,300 hectares (2,000 to 5,700 acres) in size. They will be served by pipelines. Most of the irrigation will be done by center point pivot sprinklers. New side-roll sprinklers are also being developed.

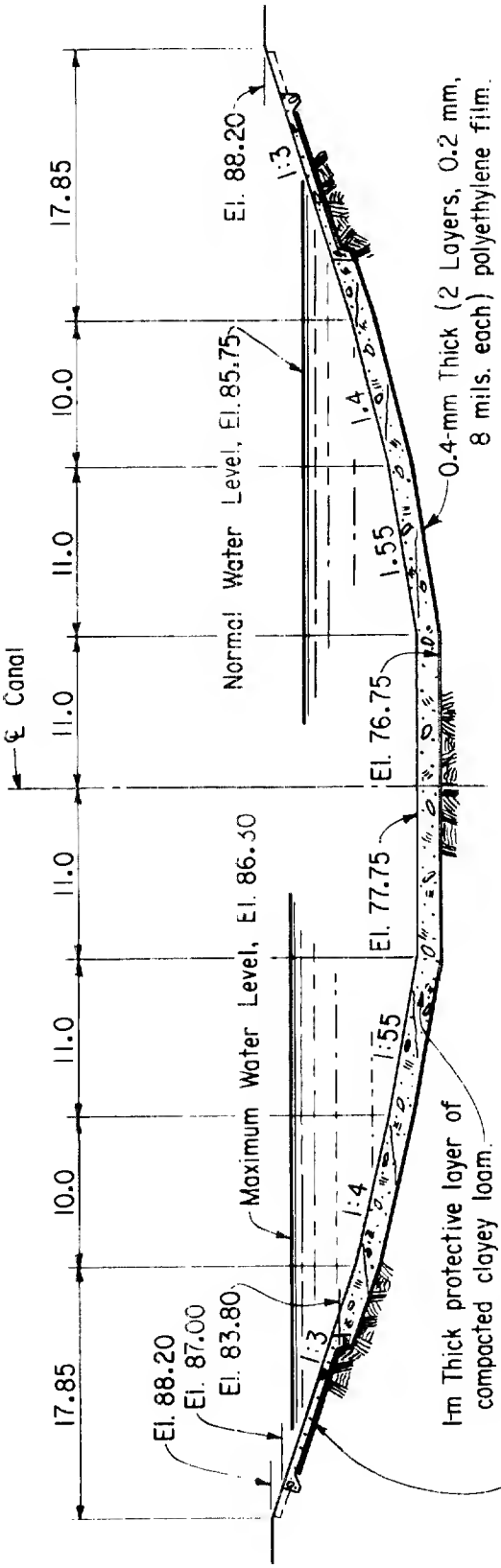
The ground-water level is deep, generally 30 to 40 meters (100 to 130 feet) below the ground surface. They expect the ground-water level to rise after irrigation starts, thereby requiring drainage. Both open and pipe drainage systems will be used, dependent on geologic conditions. They have only 5 or 6 years experience building buried pipe drainage systems and pipe irrigation systems.

In the southern area, where the soils are saltier, the plan is to install drains concurrently with the construction of irrigation laterals. Also, where drainage problems are expected within 10 years, the drains are to be constructed now. Where problems are expected beyond 10 years, drain construction will be deferred until problems arise. Pipe collector drains are now constructed of asbestos cement or plastic. Irrigation pipe is normally made of steel or cast iron. More asbestos cement is to be used in the future. Project personnel indicated dissatisfaction with the irrigation pipe now used. Fiberglass mat is used as a drain filter material.

The capital cost to build a system is approximately 2,900 to 3,200 rubles per hectare, of which 1,700 rubles is for the supply systems. It takes 8 to 10 years to return the capital investment. Return on investment was defined as the value of the gross increase in production less maintenance.



KAKHOVKA CANAL SYSTEM



Note: Dimensions and elevations are in meters.

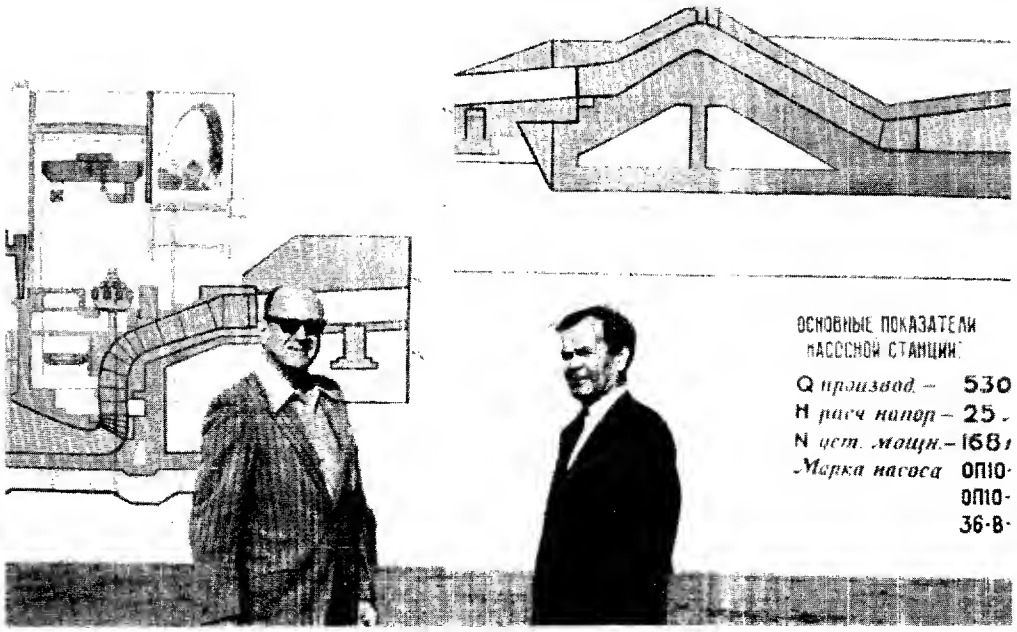
TYPICAL CROSS SECTION FOR MAIN CANAL

Two modern concrete canal lining machines from R. A. Hanson Company in Spokane, Washington, are being purchased for use on the system according to project personnel.

Mr. Gorbachyov, Chief of Construction, explained technical details of the construction of the pumping plant. The discharge lines had siphon-type outlets, with siphon breakers. The structure appeared to be very similar to the outlet on the Dos Amigos Pumping Plant in California. The delegation was driven along the canal bank to the first check which is 38 kilometers (23.5 miles) below the pumping plant. The drop in the canal to this first check is 1.5 meters (4.9 feet). The canal was full of water to this point. The check gates were in the lowered position and the check outlet was being completed. For unexplained reasons, no pictures of the check were permitted. The finish of the concrete was poor. The flow in the canal above the check was very low, serving only two smaller upstream side canals. Mr. Vradi was the engineer in charge of construction of the check. The check has three gates, 12 meters (39.3 feet) wide each. The gate bays are raised above the canal invert. The design capacity of the check is 300 m^3/s (10,700 ft^3/s). The structure is about 75 meters (245 feet) long and for a distance of 500 feet below the check, reinforced concrete had been placed to a thickness of about 20 centimeters (8 inches) to withstand the energy dissipation at the structure.

The delegation proceeded down the canal to a point where it was under construction. Mr. Varvarov, the engineer in charge, met the delegation and explained the procedure for canal construction. Two layers of polythelene (PE) plastic sheets 8 mils in thickness, are placed transversely across the whole canal prism. The PE is delivered in rolls 16 meters (52.5 feet) wide and is field jointed by a thermal process. Monolithic concrete is then placed over the PE film in the beach zone area. The monolithic concrete is 9 meters (29.5 feet) in width and 14 to 16 centimeters (5.5 to 6.3 inches) in thickness. The loosely placed plastic film is then covered with earth to a depth of 1 meter (3.3 feet). A scraper deposits the earth and a bulldozer spreads it. The canal reach above the first check has been in operation about a year and the Soviets found no evidence of sliding of the earth nor the film. They said the canal has been subjected to a drawdown of 3 meters (9.8 feet) in 4 hours without trouble. The engineer in charge said that they had made ponding tests and had virtually no leakage. The canal design velocity is 1.05 meters (3.45 feet) per second. The canal looked good, except for the surface of the monolithic concrete which was very rough. The earth cover material appeared to be a sandy clay material.

The delegates then visited a park characterized by many varieties of trees, and had lunch nearby. After lunch, the delegates briefly



Left to right: H. G. Arthur, coordinator of U.S. Group; Mr. Gorbachyov, Chief of Construction of pumping plant to Kakhovka Canal.

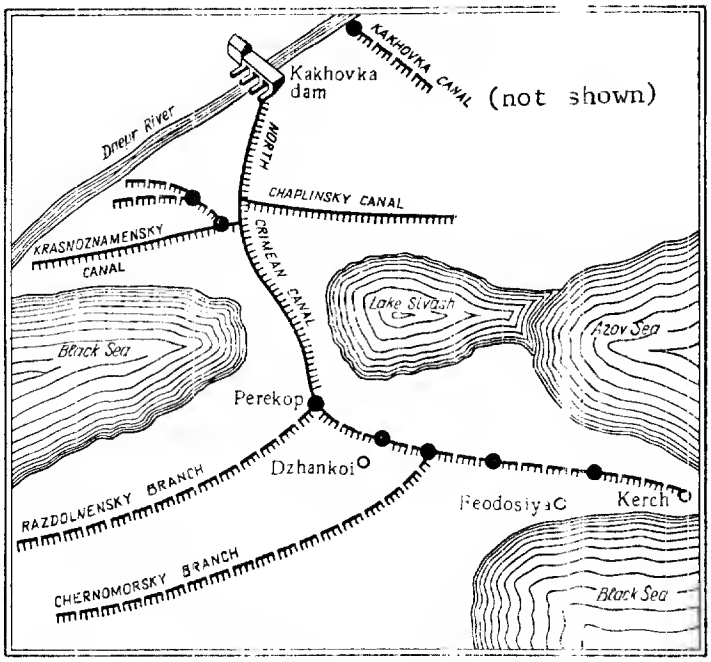
visited a good zoo. After this, the delegation viewed the R-2 canal whose source is the Kakhovka Canal. Capacity of the R-2 canal is 65 m^3/s (2,300 ft^3/s). It has the same type of lining as the main canal except the monolithic concrete lining is a little thinner, about 14 centimeters (6.3 inches). The farm laterals are constructed of steel or cast iron, rubber-gasketed pipe designed for a pressure of 150 lb/in^2.

On September 20, the tour began at the outlet of the pumping plant serving the R-1 canal. It is about 8 kilometers (5 miles) from the beginning of the Kakhovka Canal. Its lift is 14.6 meters (48 feet) and its design discharge is 13.6 m^3/s (485 ft^3/s). There are four pumps, each pumping 3.4 m^3/s (121 ft^3/s). The R-1 canal is 32 kilometers (20 miles) long. The bottom of the canal is constructed of monolithic concrete and the sides are precast. There is polythelene film under both sides and the bottom. There will be 17 pumping stations along the canal. Three are in operation now and five are under construction. The R-1 canal will serve 27,000 hectares (67,000 acres); 3,200 hectares (79,000 acres) are irrigated now. Irrigation is predominately by center-pivot-type sprinklers.

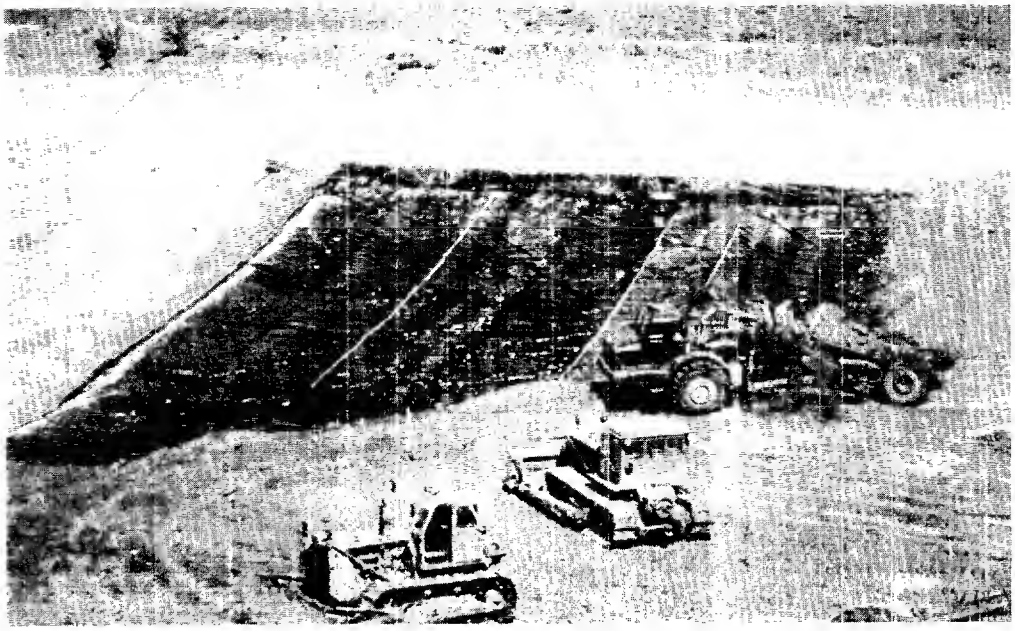
After driving along the R-1 canal, the group stopped at its first pumping plant. The canal was lined with cast-in-place concrete in the bottom and had precast sides. The precast concrete slabs on the side slopes were prestressed, 6 centimeters (2.4 inches) in thickness. They are constructed in standard widths of 1, 1.5, and 2 meters. Concrete strengths were 250 kg/cm^2 (3,500 lb/in^2) for the cast-in-place concrete and 400 kg/cm^2 (5,600 lb/in^2) for the prestressed. Its frost resistance was rated at 150 cycles in the Soviet test which measures the number of cycles required for a 50 percent drop in compressive strength. Frost resistance is important because they plan to dewater the canal each winter thus exposing it, while saturated, to temperatures of minus 20° C. The lateral is being used to experiment with various types of joint. They prefer a narrow joint partially filled with a cement mortar, then an antisticking substance is painted on the mortar followed by the placement of a polysulfide sealant.

At a way point, the group visited a monument erected by the Soviet Government commemorating its victory in the Ukraine during the Civil War which took place from about 1917 to 1920. It is a large, impressive sculpture of four horses pulling a cart with three men and a machine gun.

The group observed an experimental farm for research on subsurface irrigation using buried, perforated plastic tubing. The 12-hectare (30-acre) farm is divided into four equal sections. Water and air are introduced intermittently. They are introduced progressively into the 8-centimeter (3.1-inch) diameter main lines, then the smaller distribution lines and finally the laterals. The PE tubing is welded (joined)



Layout of the North Crimean Canal (From A. N. Askochensky)



Kakhovka Main Canal. Equipment placing and spreading 1-meter-thick earth cover over film.

Canal with precast concrete panels being placed over PE film lining.

by heat. It has cone-shaped perforations which are made with steam-heated needles. The air going out through the perforations tends to form a filter at the hole (the smaller particles are pushed out). An air compressor supplies the air. The water pressure in the main line is about .45 atmospheres and in the laterals about .15 atmospheres. The soil moisture as well as the temperature and salinity are automatically monitored.

The headworks to the North Crimean Canal were viewed by the delegates, although no photographs were allowed. This headworks, built in 1956, is described and illustrated in technical literature. The gravity flow from Kakhovka Reservoir is controlled by two 20-meter (66-foot) wide radial gates. The canal appeared to be operating at about one-half capacity when visited. The canal, which has a trapezoidal section having a beginning depth of 5.8 meters (19 feet) and a bottom width of 60 meters (197 feet), will be 400 kilometers (25 miles) long when completed. Its capacity is 295 m^3/s (10,500 ft^3/s) at the headworks. Plastic membrane is used extensively for seepage control. There will be three relift pumping plants. The third plant is under construction.

The North Crimean Canal system is a large irrigation scheme started in 1962. Its gross area is 1,400,000 hectares (3,500,000 acres) of which 600,000 hectares (1,500,000 acres) are to be eventually irrigated. The area is characterized by complicated geology including gypsum, expansive clays, and cavernous limestone requiring various types of lining and subsidence control. A total of 370 kilometers (230 miles) of canals have been constructed since 1962. A total of 150,000 hectares (370,000 acres) are under irrigation. A second canal is now being designed to serve an additional 300,000 hectares (740,000 acres). Drains for 40,000 hectares (99,000 acres) have been constructed. Additional drainage systems are being constructed. Eventually 185,000 hectares (455,000 acres) will require drainage.

They feel that the capital cost will be returned on an average in 8 years, with some crops, such as rice, returning the capital cost in 4 years.

The system will eventually serve 73 collective farms. The main system is remotely monitored and controlled from a control center at the headworks.

The delegation left Kakhovka about 2:30 p.m. on September 20, arriving in Kherson, via surface transportation, about 4:00 p.m. It enplaned there and arrived in Leningrad, via Minsk, at about 10:30 p.m.

Leningrad

Leningrad is a beautiful city. It is situated on more than 100 islands. The delegation toured the city on the weekend of September 21-22. It visited the impressive Petrodvorets and the cemetary where 600,000 of Leningrad's War II casualties are buried. The city was under siege for 900 days and about one-half of the population died from starvation, bombs, and shelling. On Sunday, the group visited the beautiful Pavlovsk (Pauls palace) and the Hermitage. The Hermitage is a large museum (formerly the Tsars winter palace), where are displayed a fabulous collection of works of art collected by the rulers of Russia prior to the 1917 revolution. Sunday evening there was a very entertaining circus performance.

On September 23, the delegation visited the Northern Research Institute of Hydraulic Engineering and Land Reclamation in Leningrad. The group was welcomed by the Deputy Director of the Institute, Mr. V. F. Tsilikin in the absence of the Director who was ill. We were introduced to seven staff members (Appendix 5), all of whom are involved in the use of new materials at the Institute.

The Institute was organized in 1923. It has 15 laboratories and divisions and field stations with experimental farms. The field stations are scattered throughout the U.S.S.R. and are organized similarly to the Institute. Each station has from 20 to 25 scientists and each experimental farm covers from 1,500 to 2,000 hectares (3,700 to 4,900 acres) and possesses about 400 head of cattle. The experimental farms have been established in the last 4 or 5 years. The overall number of people in the Institute and field stations is 1,500 of which 550 are scientists and engineers. The Institute operates a graduate or training program maintaining 30 full-time students and 20 part-time students. Part-time students divide their efforts between work and study. The Institute serves the European part of the U.S.S.R. plus specialized research for governmental organizations in all of the Soviet Union.

The questions or problems that the Institute addresses are as follows:

1. Development of irrigation and drainage systems. (Both dual acting and conventional separate systems.)

2. New approaches to production and mechanization.

3. Cultivation of reclaimed land, rapid cultivation, etc.

4. Use and operation of reclaimed land.

5. Study of economics of increasing productivity and lowering costs (increase efficiency).

6. Water conservation.

One of the main efforts is devoted to mechanization of construction. This includes the study and acquisition of foreign equipment as well as the innovative development of machinery. The process of development is encompassed in a three-step concept:

1. Laboratory research of new ideas

2. Engineering and development

3. Machinery fabrication

The Institute is in the process of building a factory to produce machines such as trenchers, cultivating discs, and land clearing machines. A new residential building is being constructed at the Institute. To be completed in 1974, it will include 90 apartment units for personnel.

The transfer of technology within the Soviet Union is handled through the Government Committee on Science and Technology. It distributes information and coordinates all activities in similar areas. Also, technical conferences are held in specialty areas.

The northern area of the European part of the Soviet Union has an overall surplus of water. Irrigation is required in only 1 to 2 months of the year. Drainage is the main problem in this area. Mr. T. S. Borshchov described an 8-year period of drainage experience using buried plastic tubing.

There are several producers of corrugated plastic tubing in the Soviet Union. It is furnished in rolls 200 meters (660 feet) long, weighing 32 to 35 kilograms (70 to 77 lb). The maximum diameter is 160 millimeters (6.3 inches).

Three basic approaches to laying plastic tubing in the ground are used:

1. Narrow trench - 25 to 30 centimeters (10 to 12 inches) in width by 170 centimeters (5.6 feet) deep.

2. Conventional trench - 50 centimeters (20 inches) in width by 2 meters (6.5 feet) deep.

3. Trenchless.

In the southern, dry parts of the country, the pipe is laid deeper than in the more humid north. The corrugated tubing is unreeled from a roll carried on the trenching machine. The narrow trencher is a screw-type excavator. The All Union Institute for Construction Machinery is developing an experimental series of fully mechanized laying machines. A limited amount of drain construction is now performed in the winter by breaking up the frozen ground with a rooter ahead of the trencher. More year-round construction of drains is anticipated.

Although plastic tubing costs slightly more than clay tile, its use is less expensive because of an estimated saving of 30 to 40 percent in labor. The main saving is in transportation and in laying. The main advantage of plastic tubing is its light weight, its good infiltration characteristics and its adaptability to mechanization. About 30 percent of their pipe drains are constructed of PE (and some PVC) corrugated tubing. The remaining 70 percent is clay tile.

The trenching machines for laying corrugated tubing are largely experimental. Originally scheduled field demonstrations did not develop. Many photographs and literature, however, were made available to the delegation. The Soviets are obviously embarked on a large drainage program and are exerting much effort to advancing the technology.

The laboratories at the Institute have developed mathematical models of drainage problems. The research is divided into three categories: (1) extending the life of the tubing; (2) reducing infiltration of sediments into the tubing; and (3) increasing the water intake into the filter material and into the tubing.

Mathematical models for investigating filter materials for various soils, filters, and tubing have been developed. Experiments using different soils and sizes of infiltration holes in the tubing have been conducted. The bridging effect of soils over openings has been studied mathematically and in the laboratory. The satisfactory range of holes varies from 0.5 millimeter for fine soils to 1.0 millimeter for peat and 1 millimeter plus for the coarser grained soils.

The visitors were shown samples of plastic connectors for clay tile. The connectors allow water intake. Samples of several types of experimental plastic drainage tubing having many kinds of slots or holes were also shown. In some samples, the slots were sawed and in other samples, the holes were cold punched or were punched with hot needles. The expressed preference was for holes on the large diameter (crest) of the corrugations as opposed to the U.S. preference on the small diameter (valley). The explanation for the U.S.S.R. preference was that the effective diameter of the drainage tubing is increased insofar as water intake is concerned. They also have concluded that the bridging action at the infiltration hole is improved.

The Division of New Building Materials at the Institute conducts research on nondestructive tests of plastic materials such as polythelene and polyvinyl chloride for drainage tubing, and other polymer materials.

Of the many possible physical tests, technicians in the Division believe that the mathematical model demonstrates that plastic is more suited to shear tests than other physical tests. Therefore, their apparatus tests for shear using basic torsion-type tests.

Division personnel showed equipment in which the ultrasonic method for measuring the angle of refraction of the material is employed. From this, the shear modulus of the material can be determined. The tests are made in a wide temperature range. Dynamic test results are measured by electronic equipment. They are studying polythelene film by the above dynamic-test method. They have also developed what they consider a simple machine which measures the time dissipation of an applied torque and from four oscillations, they can obtain the shear modulus very quickly for a temperature range of minus 15° to 50° C. This dynamic method is used on polythelene film strips.

A similar procedure is used for pipe. The pipe is placed in a torsion-test apparatus and the resonance frequency is measured. The electronic equipment then measures/monitors/records the dynamic properties and automatically computes the shear modulus.

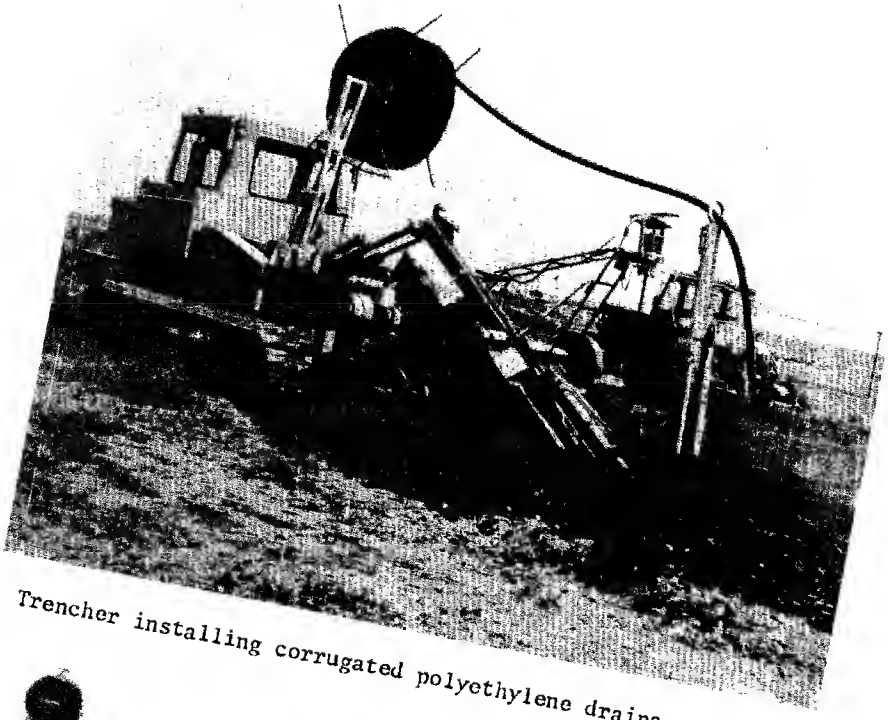
The above-described nondestructive methods are used for quality control purposes.

At the conclusions of the meetings and tours of Institute facilities, many technical articles were given the delegation. In the evening it was entertained at a very good dinner and dance music.

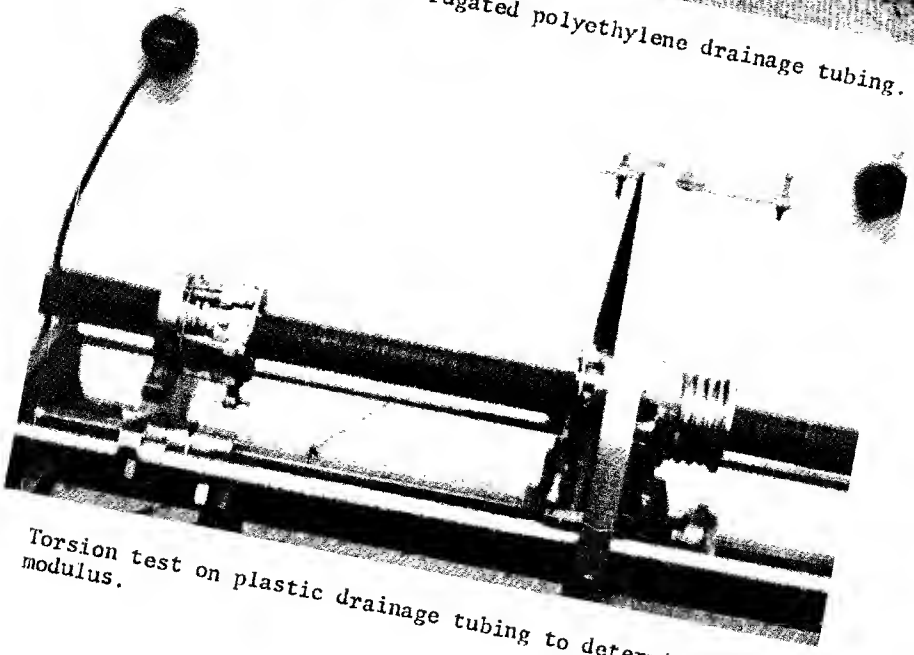
Riga

On September 24, the group traveled to Riga, where it was welcomed at the airport by Mr. Sviklis who had left us on September 20 after our arrival in Leningrad. The delegates were shown some of Riga's many areas of historical interest dating back to the 11th and 12th centuries. Outside the city is the site of a German concentration camp during World War II, where thousands perished. The memorial at the site was very impressive. That evening, the members of the delegation were once again guests at an excellent dinner.

The delegation visited the Ministry of Land Reclamation and Water Management of the Latvian SSR in Riga on September 25. The delegates were welcomed by G. N. Walker, Deputy Minister. Appendix 6 is a list of the U.S.S.R. participants in sessions at the Ministry.



Trencher installing corrugated polyethylene drainage tubing.



Torsion test on plastic drainage tubing to determine shear modulus.

In Latvia, 40 percent of the area is devoted to agriculture. The remainder is forest and water. There are 2.6 million hectares (6.4 million acres) of agricultrual land, of which 86 percent, 2.2 million hectares (5.4 million acres), cannot be used without drainage. Approximately 70,000 hectares (173,000 acres) have been drained using subsurface drains during the last 100 years with most of this work done since World War II. Most of the early drains were open ditches; however, the Russians have approximately 125 years experience with subsurface drainage work in the area. Open drains impede farming and the movement of machinery. Authorities are therefore, directing their efforts towards subsurface drainage. In September of this year, a milestone was reached when 1 million hectares (2.5 million acres) had been drained, leaving 1.2 million hectares (2.9 million acres) to be drained. This remaining 1.2 million has some of the most difficult terrain to drain.

Although Latvia is in an area of heavy rainfall, some irrigation is required in dry years for certain crops such as vegetables, irrigated pastures, and feed grains. Irrigation increases yields substantially in these dry years. There is practically an unlimited water supply. The spring runoff constitutes 80 to 90 percent of the water in the streams. Topography is very flat which makes reservoir construction difficult and good reservoir sites are scarce. Latvia is completing its third reservoir on the Daugava River. This is the largest river in Latvia. The main purpose of the dams is to produce hydropower but their stored water is also consumptively used. Small reservoirs are a new trend, and a number of them have been recently built. The area of reservoirs constructed in the last year totals 5,000 hectares (12,300 acres). The Soviets expect to drain 100,000 hectares (247,000 acres) this year and to complete the total drainage program in the period from 1985 to 1995. In each of the next 5 years, approximately 100,000 hectares (247,000 acres) are to be drained according to present schedules.

There is a sufficient supply of clay tile pipe. This has not always been the case. Clay pipe, however, requires considerable hand labor to lay, and there is a shortage of labor. The Baltic states have a low birth rate, so authorities are investigating new materials, such as plastics, whereby construction labor may be less in demand. The interest is in plastic tubing for drainage and in plastics for irrigation pipe and film linings. Plastic pipe holds promise in irrigation distribution systems, and film linings are expected to be used increasingly to reduce reservoir losses. Some small reservoirs have large water losses at sites where the geologic conditions are unfavorable. There is also interest in inflatable dams for small structures. Several inflatable dams may be installed next year.

Mr. V. A. Kalntsiyems, Head, Division of Land Reclamation Structures, stated that the Ministry is divided into three divisions:

1. Design and Engineering
2. Construction
3. Operations

He explained the duties of each division. All divisions have under them Institutes doing work. Completed designs are given to the construction division for implementation. Quality control is done by specialists from the Operations Division. Final acceptance of work is also done by the Operations Division. The Operations Division operates the systems except those on the farm. Farm operations are conducted by farm collectives. The largest construction activities are drainage, dams, and pumping plants. Next in importance are land clearing and neutralization of acid soils. They also spend approximately 1 million rubles per year on the construction of fishponds peat mining, and forest drainage. In Latvia, the Ministry has 1,000 trenchers, 700 draglines, and 1,500 pieces of other equipment. They employ 15,000 people. Their budget is 110 million rubles per year of which approximately 30 percent is for salaries.

Mr. P. V. Sviklis, the Director of the VNIIVODPOLYMER (All Union Scientific Research Institute on Application of Polymer Materials for Land Reclamation and Water Management), described his past responsibilities as relating primarily to work on problems in Latvia, but he said his future work will be on All Union problems. The Institute's responsibilities are in two areas: (1) general reclamation; and (2) polymer applications. Currently the staff is divided equally between the two areas. The Institute has 330 people, 70 of whom are in plastic applications. About one-half of the 330 people are trained as engineers or scientists. Of the 70 working in plastic applications, some are designers of pipe and some of pipelaying machinery. Their experience in plastic dates back 4 or 5 years. They have developed drain design standards for depth, spacing, and diameter for Latvian conditions. They first installed plastic drains in 1963. They have subsequently experimented with various types of pipe and filter materials.

In some years, there is sufficient rainfall and no irrigation is required in Latvia. In dry years, irrigation increases yield of feed-crops and vegetables 2 to 2-1/2 times. Irrigation of vegetable crops located close to cities was mentioned as particularly economically feasible. They have a few systems using PE plastic irrigation pipe and they have used PVC plastic pipe to a limited amount. One PVC system is currently under construction.

They are doing experimental work in their laboratories on the mechanization of placing drainage tubing and in the design of pipe. They have made experimental plastic pipe up to 30 centimeters (11.8 inches) in diameter. The samples of the 30-centimeter (11.8-inch) diameter pipe shown to the visitors was double walled. At the conclusion of the meeting, Mr. Sviklis distributed many photographs of various pipe-laying machines, experimental pipe, and fittings. He also provided literature on plastic pipe.

The remainder of September 25 was devoted to drafting the Record of Meeting, including its important Supplement II, the Joint Program of Work through 1980. On September 26, the U.S. delegation working with the U.S.S.R. Working Group, headed by Mr. Sviklis, completed the Record of Meeting. Mr. Kharin joined the U.S.-U.S.S.R. representation, having traveled from Kiev the night before. After the draft was satisfactory to the U.S. and U.S.S.R. representatives, it was typed in both the English and Russian versions. It was ready by noon. There was previous agreement that the draft should be reviewed in Moscow and the final version of the Record signed there by the Coordinators.

After lunch, the group traveled to Moscow, arriving there about 4:30 p.m. After its arrival, Mr. Arthur made arrangements to visit the American Embassy the next day, so that interested persons there could review the Record before it was signed.

Moscow

Messrs. Arthur, Rodzianko, and Thorsky met with Mr. John Ward, Science Counselor in the American Embassy at 10:00 a.m. The meeting lasted for about half an hour. Mr. Ward examined the Record of U.S.-U.S.S.R. Joint Project Group Meeting that had been drafted in Riga. He thought it satisfactory. Some of the most pertinent features were pointed out, such as the fact that the May 24, 1972, Agreement is for 5 years and that it would eventually require an extension because the Project II-3 program goes through 1980. Also, the performance of the program is contingent upon the availability of funds. Mr. Arthur pointed out that the Record stated that direct communications would be desirable. Mr. Ward suggested that Mr. Arthur send all correspondence direct to the Science Counselor, American Embassy in Moscow, State Department, Washington, D.C. 20520. By using this procedure mail would be placed in a diplomatic pouch in Washington and sent directly to the American Embassy in Moscow. Whereupon Mr. Ward, or his staff, would send it through the mail in the Soviet Union. The U.S. delegation returned to its hotel and awaited word from the Ministry for Land Reclamation and Water Management. About noon it was informed that the Ministry wished to discuss several changes in the Record at a meeting following Ministry review. Meanwhile, the delegation visited the exhibit

on Reclamation, which was part of the more comprehensive Exhibition of Economic Achievements at a facility in the suburbs of the city.

Reclamation activities are displayed permanently in a separate building at the Exhibit. The display was impressive. The guide at the exhibit stated that some 13 million hectares (32 million acres) were to be irrigated in the Soviet Union by 1990. It is planned that all work in Reclamation will be finished by then, according to the guide. Between 1975 and 1990 some 9 to 10 million hectares (22 to 25 million acres) are to be brought under irrigation, and 2-1/2 million hectares (6.2 million acres) are to be drained. Plans for diverting water from the north to the south through a series of tunnels, canals, dams, and pumping plants were shown in part of the exhibit. In one scheme the water would be diverted to raise the level of the Caspian Sea. Also shown was an ambitious project to reclaim forests, as well as plans for the Crimean Penninsula and southern steppe regions.

Another scheme viewed was the Karakynskii Canal. Its capacity is 320 m^3/s (11,500 ft^3/s) at the beginning and its length is 1,400 kilometers (930 miles). Currently 900 kilometers (600 miles) are finished. We were also shown a scheme in the Northern Caucuses. This is the principal rice growing area and the key feature is the Krashonars Reservoir.

The last few minutes were spent in viewing schemes for pollution control and plans for handling industrial wastes and sewage.

The U.S. delegation met at the Ministry at 4:15 p.m. to discuss the Record of Meeting. All members of the delegation were present except for Mr. Philleo. The Soviet participants are listed in Appendix 7. Mr. Bessrebrennikov spoke for the Ministry.

After considerable discussion, final agreement on the Record of Meeting was reached about 9:00 p.m. The narrative portions of the Record were signed by Mr. Arthur and Mr. Sviklis at about 4:30 p.m. on September 28 at the Ukraine Hotel. Supplement II to the Record was not ready so it was agreed that it would be typed in English in the United States and sent to the U.S.S.R. The Soviets would likewise send the typed Russian version of Supplement II to the U.S. The U.S. group, since their return, sent Supplement II in the English language to the Ministry in Moscow whose address in Moscow 107139 Orlikov Lane 1/11, U.S.S.R. Ministry for Reclamation and Water Management Department for Scientific and Technical Cooperation with Foreign Countries, U.S.S.R. A copy of the Record of Meeting including Supplement II, constitutes Appendix 8 of this report.

While waiting for the signing of the Record of Meeting, the Ministry arranged a visit to Moscow University. The group also visited

Khruschev's grave, which is on the grounds of an old convent that is now being used as a museum.

After the signing, the Soviets served champagne; toasts of good will were exchanged with expressed hopes for the success of the agreed-upon Cooperative Exchanges.

That evening, the Soviets hosted the United States delegates to a ballet performance of the Nutcracker Suite at the Bolshoi Theatre.

On September 29, 1974, the United States delegation departed Moscow for the United States as scheduled.

Observations and Conclusions

The Soviets are deeply involved in the use of plastics in hydroconstruction. Evidence of the importance attached to it is indicated by establishment of the All Union Research Institute for Use of Polymers in Reclamation and Water Management. The directorship of the Institute is held by the U.S.S.R. Coordinator of Project II-3, Mr. Sviklis.

Emphasis on Reclamation planning is currently relatively greater in the Soviet Union than in the United States. They apparently have active plans to divert huge flows from the northward-flowing rivers east of the Urals to the water-deficient south. Such diversion would irrigate southern lands and raise the level of the Caspian Sea. The planned canals would be many times larger than anything thus far constructed in the United States.

The American delegation on Project II-3 achieved most of its objectives on this visit to the Soviet Union. The delegates became acquainted with the state-of-the-art of plastics in hydrotechnical construction in the Soviet Union. A program for cooperative efforts in four main categories of work was agreed upon through 1980. The Record of the Meeting (Appendix 8) anticipates the exchange of technical specialists in several significant work categories. The approved program is specific as to the elements of work included in the joint technical effort. The commitment of U.S. II-3 Group members to assignments made by the U.S. Coordinator appears to assure implementation of the programed work.

The Soviets were cooperative, genial hosts. They extended many courtesies including complementation of the technical mission by a cultural blend of sightseeing and entertainment. The delegates visited many design and research institutes that apparently are devoting considerable engineering and scientific effort toward advancing the use of plastics in U.S.S.R. reclamation activities. Visits to construction sites were limited to canal systems in the Ukarine. The group anticipated visits to a site near Leningrad where plastic drainage

tubing was being installed and a factory in Moscow where plastic film is being manufactured. Neither of these visits materialized.

Plastic membranes (polyethylene) to reduce seepage losses in large canals are used more extensively in the U.S.S.R. than in the United States. In small canals, membranes are used under concrete lining (monolithic and precast concrete); in large canals, plastic membranes are covered with about 1 meter (3.3 feet) of earth. Large canals in the United States are normally lined with unreinforced concrete having small plastic water stops for crack and seepage control. The Soviets said they are obtaining seepage losses in their membrane-lined canals of 6 to 8 liters/m^2/day (.02 to .026 ft/ft^2/day) which is comparable to our concrete-lined canals with plastic, joint control water stops. The Soviets also claim economy of construction by using plastic membrane covered with earth for the major length of the wetted perimeter. They concrete line the beach zone only. They have purchased two modern concrete-lining machines from this country.

Soviet practices need more study and evaluation by U.S. specialists to determine the applicability of their experience to our needs. The program accommodates a visit of U.S. specialists to the U.S.S.R. during the second quarter of 1975.

The Soviets are actively advancing the use of plastic tubing and prefabricated filters (fiberglass) for drainage. They showed the U.S. delegation many samples of pipe and filters and a prototype auger-type trencher/plow. The auger is hollow and the tubing with its fiberglass filter is fed through it. Soviet laboratories are developing nondestructive dynamic tests for quality control for both plastic membrane and pipe. In contrast to the activity in plastic drainage tubing there is much less involvement in the area of plastic irrigation pipe.

The Soviet Union appears to be ahead of the United States in terms of the application of polymer concrete in hydrotechnical construction. Soviet technologists claim to have used it successfully, and economically, in structures subject to abrasion and cavitation. They are familiar with U.S. research in polymer-impregnated concrete and acknowledge its excellence.

Other areas of Soviet technological activity include: development of materials to protect metals from corrosion, chemicals to cement riprap, petroleum products mixed with soil (or sprayed) for seepage control, chemicals to improve soil texture and joint sealants.

The future program of work and the exchange visits contemplated under Project II-3 take into account the state-of-the-art and the needs of each country. Further cooperative efforts and contacts by technical specialists can prove to be mutually beneficial.

APPENDIXES

Appendix No. 1

ITINERARY

September 12 Thursday	Arrival at Sheremetyevo Airport, Moscow. Accommodation at the Hotel Rossia.
September 13 Friday	Confer with officials at the U.S.S.R. Ministry for Reclamation and Water Resources. Visit American Embassy.
September 14 Saturday	Visit International Exhibition Polymer '74.
Septempber 15 Sunday	Sightseeing - The Kremlin and the Armory. Ballet at the Palace of Congresses.
September 16 Monday	Travel to Kiev by plane. Accommodation at Hotel Moscow.
September 17 Tuesday	Confer with personnel at the Ukrainian Scientific and Research Institute for Hydraulic Engineering and Land Reclamation. Visit research facilities.
September 18 Wednesday	Confer with personnel at the Ukrainian State Institute for Design of Water Resources Development Projects. Surface travel to Novaya Kakhovka. Accommodation at Friendship Hotel.
September 19 Thursday	Confer with staff of the Construction Authority of the Kakhovka Irrigation Project. Visit Kakhovka Canal construction sites.
September 20 Friday	Visit sites on the Kakhovka Canal system, experimental farm using subsurface irrigation and North Crimean Canal headworks. Travel to Kherson by surface transportation then to Leningrad via plane. Accommodation at Hotel Astoria.
September 21, 22 Saturday, Sunday	Sightseeing and rest. Visit Petrodvorets, Pavlovsk, and Hermitage.

Appendix No. 1 - continued

September 23 Monday	Confer with personnel of the Northern Research Institute of Hydraulic Engineering and Land Reclamation. Visit laboratories.
September 24 Tuesday	Travel by plane to Riga, Latvia. Accommodation at Hotel Riga. Sightseeing - Intourist guide.
September 25 Wednesday	Confer with personnel of the Ministry of Land Reclamation and Water Management of the Latvian SSR and All Union Scientific Research Institute on Application of Polymer Materials for Land Reclamation and Water Management. Draft Record of Meeting.
September 26 Thursday	Complete drafting Record of Meeting. Travel to Moscow by plane. Accommodation at Hotel Ukraine.
September 27 Friday	Meet with Science Counselor, American Embassy. Visit U.S.S.R. Exhibition on Reclamation. Meet with U.S.S.R. Officials and Working Group to discuss Record of Meeting.
September 28 Saturday	Moscow sightseeing. Signing of Record of Meeting. Ballet at Bolshoi Theatre.
September 29 Sunday	Departure for United States from Sheremetyevo Airport.

Appendix No. 2

LIST OF U.S.S.R. PARTICIPANTS AT THE MEETING IN THE
U.S.S.R. MINISTRY FOR LAND RECLAMATION
AND WATER MANAGEMENT
Moscow, September 13, 1974

I. I. Borodavchenko	-	Deputy Minister U.S.S.R. Ministry for Land Reclamation and Water Management
N. K. Bessrebrennikov	-	Deputy Chief General Department of Science U.S.S.R. Ministry
L. F. Zimenkov	-	Chief Engineer Department of Scientific and Technical Cooperation with Foreign Countries
V. V. Medveden	-	Senior Engineer Department of Scientific and Technical Cooperation with Foreign Countries
K. E. Obrezkov	-	Chief Engineer General Department of Science U.S.S.R. Ministry
S. F. Korbut	-	Secretary of the Joint U.S.-U.S.S.R. Group
V. P. Sedunov	-	Interpreter of the Ministry
J. J. Walter	-	Chief, Division of Coordination Latvian Institute of Hydraulic Engineering and Land Reclamation
P. B. Sviklis	-	Coordinator of the U.S.S.R. Group Director of All Union Scientific Research Institute on Application of Polymer Materials for Land Reclamation and Water Management

Appendix No. 3

LIST OF U.S.S.R. PARTICIPANTS AT THE MEETING
IN THE UKRAINIAN SCIENTIFIC RESEARCH INSTITUTE
FOR HYDRAULIC ENGINEERING AND LAND RECLAMATION
Kiev, September 17, 1974

A. I. Kharin	-	Deputy Director
I. M. Yelshin	-	Chief, Division of Building Materials
V. B. Reznik	-	Senior Engineer, Division of Building Materials
P. B. Sviklis	-	Director, Latniigim, Riga
V. P. Batyuk	-	Chief, Laboratory of Watertight and Anticorrosive Linings
N. A. Palishkin	-	Chief, Division of Hydraulic Structures
V. N. Sholokhov	-	Chief, Section of Water Collection and Hydrology, Ukrniigim
E. A. Bogaton	-	Chief, Section of Machinery Research for Reclamation Machinery, Ukrniigim
I. I. Kalantyrenko	-	Chief, Section of Hydraulic Structures and Hydrology
V. V. Masalski	-	Engineer, Ukrniigim
P. I. Kovalenko	-	Director of the Institute and Candidate of Technical Sciences

Note: P. I. Kovalenko met with us near the end of the visit for a short time.

Appendix No. 4

LIST OF U.S.S.R. PARTICIPANTS AT THE MEETING
IN THE UKRAINIAN STATE INSTITUTE FOR THE
DESIGN OF WATER RESOURCES DEVELOPMENT PROJECTS
Kiev, September 18, 1974

E. A. Baksheyev (on business trip)	-	Director of the Institute
B. I. Strelets	-	Chief Engineer of the Institute
A. F. Nishcheta	-	Chief, Division of the Construction of North-Crimean Canal
N. M. Matyak	-	Chief, Division of Khahovka Irrigation Project
B. N. Belyashevski	-	Interpreter

Appendix No. 5

LIST OF U.S.S.R. PARTICIPANTS AT THE MEETING
IN THE NORTHERN SCIENTIFIC AND RESEARCH INSTITUTE
ON HYDRAULIC ENGINEERING AND LAND RECLAMATION
Leningrad, September 23, 1974

V. F. Tsilikin	-	Deputy Director of the Institute
I. E. Krichevski	-	Head, Division of New Building Materials, Candidate of Technical Sciences
B. P. Yeryhov	-	Senior Scientific Engineer
V. A. Krupin	-	Junior Scientific Engineer
N. B. Shalun	-	Head, Division of Implementation of New Equipment and Advanced Technology
I. M. Yemelianova	-	Chief, Laboratory and Reclaimed Lands Management, Candidate of Agricultural Sciences
T. S. Borshchov	-	Senior Scientific Engineer Laboratory of Technology and Organization of Land Reclamation Engineering
A. V. Myaskov	-	Chief, Laboratory of Mathematical Modeling

Appendix No. 6

LIST OF U.S.S.R. PARTICIPANTS AT THE MEETING
IN THE MINISTRY OF LAND RECLAMATION AND
WATER MANAGEMENT OF THE LATVIAN SSR
Riga, September 25, 1974

G. N. Walter	-	Deputy Minister, Latvian SSR Ministry
P. B. Sviklis	-	Director, VNIIVODPOLYMER (All Union Scientific Research Institution on Application of Polymer Materials in Land Reclamation and Water Management)
A. I. Kharin	-	Deputy Director, UKRNIIGiM (Kiev)
I. E. Krichevski	-	Head, Division of New Building Materials, SEVNIIGiM (Leningrad)
V. A. Kalntsiyems	-	Head, Division of Land Reclamation Structures
J. J. Walter	-	Head, Division of Coordination of Scientific Research Activities of the VNIIVODPOLYMER (Riga)
Ts. N. Shkinkis	-	Head, Division of Hydraulic and Land Reclamation Systems
D. H. Baylin	-	Chief of Laboratory, Mechanization and Technology of Construction, VNIIVODPOLYMER
U. G. Tims	-	Chief of Laboratory, Automated Systems of Control and Experimental Implementation, VNIIVODPOLYMER
U. J. Ozolants	-	Senior Interpreter, Division of Scientific Research Activities VNIIVODPOLYMER (Riga)

Appendix No. 7

LIST OF U.S.S.R. PARTICIPANTS AT THE MEETING IN THE
U.S.S.R. MINISTRY FOR LAND RECLAMATION
AND WATER MANAGEMENT
Moscow, September 27, 28, 1974

N. K. Bessrebrennikov	-	Deputy Chief General Department of Science U.S.S.R. Ministry
L. F. Zimenkov	-	Chief Engineer Department of Scientific and Technical Cooperation with Foreign Countries
V. V. Medveden	-	Senior Engineer Department of Scientific and Technical Cooperation with Foreign Countries
S. F. Korbut	-	Secretary of the Joint U.S.-U.S.S.R. Group
P. B. Sviklis	-	Coordinator of the U.S.S.R. Group Director of Latvian Institute
J. J. Walter	-	Chief, Division of Coordination Latvian Institute of Hydraulic Engineering and Land Reclamation

APPENDIX NO. 8

RECORD
OF
US-USSR JOINT PROJECT GROUP MEETING ON PROJECT II-3
"PLASTICS IN HYDROTECHNICAL CONSTRUCTION"

Moscow, USSR September 28, 1974

I

1. In accordance with the US-USSR Agreement on Cooperation in the Fields of Science and Technology signed May 24, 1972, and the decisions of the US-USSR Joint Commission on Scientific and Technical Cooperation, and the results of discussions of the first meeting of the US-USSR Joint Working Group on Scientific and Technical Cooperation in the Field of Water Resources signed September 30, 1972, the second meeting of the US-USSR Joint Project Group on Plastics in Hydrotechnical Construction was held in Riga and Moscow, USSR, September 25-28, 1974.

2. Project coordinators who headed US and USSR groups:

For the US :

H.G. Arthur, Director of Design and Construction, Bureau of Reclamation

For the USSR :

P.B. Sviklis, Director of VNIIvodpolymer

The list of participants is attached (Supplement No 1).

3. The following items were discussed :

1) Progress on joint cooperation to date.

2) Joint Program of Work for USSR-US Scientific and Technical Cooperation on II-3 "Plastics in Hydrotechnical Construction" for 1974-1980.

3) Exchange of groups of scientific specialists between USSR and US.

II

1. The coordinators noted that satisfactory progress has been made in accomplishing the program as outlined in the Record of Agreement signed on July 24, 1974 in Denver, Colorado USA.

These accomplishments have been made through visits by joint working group members to the US and USSR and an exchange of opinions and information on the activities carried on in each country in the field of plastics application in hydrotechnical construction.

2. The joint work program included in the July 24, 1974 agreement, was updated and expanded for the 1974 through 1980 program. These amendments were made in accordance with the interests of both the American and Soviet Sides. It was further agreed that the program may be revised through joint agreement as the need arises during program implementation.

Since the completion of all base topics of the cooperative program demands considerable time, the program extends through 1980. This program is conditioned on the extension of the basic Agreement on Scientific and Technical Cooperation between the US and USSR signed May 24, 1972.

3. Both groups find it advisable to periodically exchange materials and documentation of work activities in order to provide timely information necessary to efficiently implement the program. The exchange of materials will be made by the coordinators; the US coordinator points out that direct communications are considered necessary to complete the program on schedule.

4. The necessity of exchange of groups of scientific specialists between the US and the USSR in accordance with the cooperation theme (II-3) in 1975 was also discussed at this joint meeting. It was agreed that a visit of US specialists to the USSR to confer and to make detailed plans for carrying out programmed activities for categories of work II-3-1 and II-3-2 will be made during the second quarter of 1975. During the same year a visit of USSR specialists will be made to the US for similar activities for categories of work II-3-1 and II-3-2.

It is contemplated that additional exchanges will be found necessary during the 1976 to 1980 period, as the work progresses.

5. During the visit in the USSR the U.S. group became acquainted with the work of Research and Design Institutes and technical solutions and practices used at hydrotechnical construction sites. The following were visited :

- Ministry of Reclamation and Water Management of the USSR ;
- Ukrainian Research Institute of Reclamation and Water Resources (Ukrainian NIIGiM) ;
- Ukrainian State Institute for Designing Hydrotechnical Construction ;
- Northern Research Institute of Hydrotechnics and Reclamation ;
- Ministry of Reclamation and Water Management of Latvian SSR ;
- International Exposition "Polymeri - 74" in Moscow ;
- All-Union Exposition "V.D.N.Kh." (the pavilion Reclamation and Water Management);
- Construction Sites of the Kakhovka canal ;
- Head Structure of the Northern Crimea canal.

The US group likewise became acquainted with the basic directions of research work of the newly established ALL-union Research Institute for Use of Polymers in Reclamation and Water Management (VNIIvodpolymer).

6. It is understood by the coordinators that financing of all activities associated with the joint works as provided by the program be realized in accordance with the decisions adopted by the US-USSR Joint Commission on Scientific and Technical Cooperation.

It is further understood that the implementation of the program is subject to the availability of funds.

7. There was desire, expressed by both sides, for early practical, beneficial results in execution of works provided by the program.

8. The project coordinators and the participants of this joint meeting state with satisfaction that the talks were fruitful and

held in an atmosphere of friendship and mutual understanding and assured further development of personal contacts, that will contribute to the development and implementation of cooperation in the field of plastics application in hydrotechnical construction.

The present document was signed on September 28, 1974 in two copies, English and Russian, both copies being equally valid.

P.B. Sviklis
USSR Project Coordinator

H.G. Arthur
US Project Coordinator

SUPPLEMENT I

LIST OF PARTICIPANTS AT THE MEETING ON
PROJECT II-3 " PLASTICS IN HYDROTECHNICAL CONSTRUCTION "

US Group :

H.G. Arthur	-	Coordinator of the Project, Director of Design and Construction, Bureau of Reclamation
W.J. Ochs	-	Water Management Engineer for Drainage, Soil Conservation Service
R.E. Philleo	-	Chief, Concrete Branch ; Office, Chief of Engineers
J.P. McGarvey	-	Technical Director - Film Operations, Arco Polymers, Inc.
G.N. Thorsky	-	Chief, Division of Engineering Support, Bureau of Reclamation

USSR Group :

P.B. Sviklis	-	Coordinator of the Project, Director of the All-union Research Institute for Use of Polymers in Reclamation and Water Management
A.I. Kharin	-	Deputy Director, Ukrainian Research Institute of Hydraulics and Reclamation of tho USSR Ministry for Reclamation and Water Management
J.J. Valter	-	Department Chief, Coordination of Research Work, VNIIvodpolymer
I.E. Krichevsky	-	Department Chief, New Building Materials, Northern NIIGiM

JOINT PROGRAM OF WORK
FOR SCIENTIFIC AND TECHNICAL COOPERATION
OF THE USSR-US WORKING GROUP ON PROJECT II-3
"PLASTICS IN HYDROTECHNICAL CONSTRUCTION" FOR 1974-1980

Category of work	Activities in carrying out work by stages	Sponsors USSR	Sponsors USA*	Duration of work	Expected results
II-3-1 Design and technology of constructing plastic film linings in canals and reservoirs. (a) Investigations of effective use of plastic membranes in construction of water management systems under different environments.	1. Exchanging scientific technical information.	NVIIVodpolymer.	Bureau of Reclamation, E&R Center, U.S. Department of the Interior	III, 1974	Improvements in methods and apparatus for investigating physical and mechanical properties of plastic membranes used in constructing seepage-controlling linings. Technical requirements of film materials for use under differing environments.
	2. Exchanging investigation methods for physical and mechanical properties and aging processes of membranes.	Northern NIIG-M. Ukrainian NIIG-M.		III, 1974 through II, 1975	
	3. Exchanging small quantities of various plastic materials for physical and mechanical tests.	NPO "Plastic."		II, 1975	
	4. Exchanging data on research equipment and technical documents on test methods.			III, 1974 through IV, 1975	

Footnote: The Bureau of Reclamation will be responsible for the overall coordination of all categories of work among the U.S. Department of Agriculture, the Corps of Engineers, and the Society of Plastics Industry. The lead agency for each category is shown in column 5.

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No.	Category of work	Activities in carrying out work by stages	Sponsors USSR	Sponsors USA*	Duration of work	Expected results
		5. Conducting complex laboratory investigations and working out technical requirements of plastic materials in use under differing environments.			IV, 1975 through II, 1976	
		6. Investigation and exchange of information on improved ultra-violet stabilizing systems toward enhancing the aging characteristics of those membranes which presently are the least resistant to exposure degradation.			II, 1976 through IV, 1979	
		7. Conducting technical investigations of performance of plastic materials under various climatic and soil conditions.			II, 1976 through IV, 1979	
		8. Exchanging information on results of physical and mechanical investigations. Discussion of results.			IV, 1976 through IV, 1979	
	b. Improving technology of installing watertight plastic linings of canals and reservoirs.	1. Exchanging scientific technical information on placement technology for plastic watertight linings.	VNIIVodpolymer. Ukrainian NIIG-M.	Bureau of Reclamation, E&R Center, U.S. Department of the Interior	III, 1974	Recommendations on the design and construction of plastic membrane lined systems which will improve their performance and reduce costs.
		2. Planning of construction of joint cooperative experimental projects in both nations with use of Soviet and American films.	Northern NIIG-M.		II, 1975 through IV, 1977	

Category of work	Activities in carrying out work by stages	Sponsors USSR	Sponsors USA*	Duration of work	Expected results
	3. Investigating and determining seepage rates of plastic lined canals and reservoirs and of other competetive types of lined systems.			II, 1975 through II, 1977	
	4. Investigating to provide better, more economical cover for plastic linings; improved field seaming methods.			II, 1975 through II, 1977	
	5. Laboratory and field testing of high density polyethylene membrane systems.			II, 1977	
	6. Studying construction technology of plastic membrane cutoffs; exchange of technical documents and work experience. Developing interim recommendations for seepage control linings.			III, 1974 through III, 1976	
	7. Evaluating any newly developed plastic membranes that may have potential as waterproof liners.			II, 1975 through III, 1979	
	8. Discussing results of various joint experiments in improvements of systems of plastic membrane linings and cutoffs (according to categories of work).			II, 1975 III, 1976 through IV, 1979	
	Completing categories No. 1 (a) and (b) preparing report, recommendations and discussing results.			III, 1980	

No.	Category of work	Activities in carrying out work by stages	Sponsors USSR	Sponsors USA*	Duration of work	Expected results
2.	II-3-2 Utilization of polymers in soil stabilization on cut and embankment slopes. (a) Investigation of effectiveness of chemical materials in soil stabilization.	1. Exchanging scientific technical information on application of stabilizing materials for earth stabilization. 2. Exchanging opinions on basic trends of work to be jointly done. 3. Conducting cooperative field tests to investigate such usages as dust abatement, erosion control, and moisture control. Researching chemical materials for stabilizing soils. 4. Exchanging performance data on new materials as they become available. 5. Discussing results of various cooperative investigations of usage of chemical materials for stabilizing soils. 6. Completing category No. 2 and preparing report.	VNIIV odpolymer. Ukrainian NIIG-M.	Bureau of Reclamation, E&R Center, U.S. Department of the Interior	III, 1974 III, 1975 IV, 1975 through IV, 1979 II, 1975 through II, 1979 III, 1976 through III, 1979 II, 1980	Recommendation on selection and use of chemical materials for soil stabilization. Improved usage.
3.	II-3-3 Investigation of effectiveness of plastic pipes in drainage and irrigation structures.	1. Exchanging scientific technical information, standards, and instructions on use of plastic pipes in drainage and irrigation, including materials and design of envelopes for drainage pipe.	VNIIVodpolymer. Northern NIIG-M. NPO "Plastic."	Soil conservation Service Department of Agriculture	III, 1974 through IV, 1975	Recommendations on usage of plastic pipes in drainage and irrigation systems. Improved specifications, quality control, joints, drainage envelopes, and construction.

APPENDIX NO. 8 - Continued

No.	Category of work	Activities in carrying out work by stages	Sponsors USSR	Sponsors USA*	Duration of work	Expected results
		2. Obtaining plastic irrigation and drainage pipe of differing technical parameters including joints.			I, 1975 through II, 1976	
		3. Exchanging information and technical documents on application of nondestructive methods for quality control of plastic pipes.			II, 1975	
		4. Encouraging development of corrugated PVC tubing and styrene rubber drainage tubing through joint research, testing, evaluation and exchange of information on testing and specifications requirements.			IV, 1975 through IV, 1977	
		5. Conducting detailed investigations of physical and mechanical properties on differing types of plastic drainage tubing and pipe considering their use under various environments.			III, 1976 through II, 1978	
		6. Planning of construction of joint cooperative experimental projects in both nations with use of Soviet and American plastic pipe.			II, 1975 through III, 1977	
		7. Investigating and developing new, more economical envelope materials for drainage systems. Exchanging ideas on ideal properties of envelope materials and what new, economically promising materials should be tried.			II, 1975 through II, 1976	

No.	Category of work	Activities in carrying out work by stages	Sponsors USSR	Sponsors USA*	Duration of work	Expected results
		8. Investigating, evaluating, and developing jointing systems for plastic irrigation pipe.			II, 1975 through II, 1977	
		9. Researching bacteria formation and its effects on plastic tubing drainage systems including existing sludge problems, their causes, prevention, and treatment.			I, 1976 through IV, 1978	
		10. Exchanging experience on designing and construction of drip and subsoil irrigation systems using plastic materials.			III, 1975 through IV, 1978	
		11. Discussion of results of various cooperative investigations of plastic pipe for irrigation and plastic tubing systems for drainage.			III, 1976 through III, 1979	
		12. Completing category No. 3 and preparing report.			II, 1980	
II-3-4	Utilization of polymer-concrete in wear and cavitation resisting linings in hydraulic structures and also in repairs of concrete units. (a) Investigation of polymer impregnated concrete (polymer impregnated portland cement concrete).	1. Exchanging scientific technical information and documents on polymer-concrete use and identifying respective properties.	VNIIVodpolymer. Ukrainian NIIG-M.	U.S. Army Corps of Engineers	III, 1974 through II, 1975	Recommendations on selecting monomers and synthetic resins and catalytic agents and promoters of polymerization for impregnation of concretes.
		2. Study of investigation methods and application experience with polymer-concretes in U.S. and USSR construction, and onsite studies.			II, 1975 through III, 1979	

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No.	Category of work	Activities in carrying out work by stages	Sponsors USSR	Sponsors USA*	Duration of work	Expected results
		3. Exchanging specimens and data on equipment to improve methods of physical and mechanical properties investigations, including nondestructive methods of quality control and accelerated durability tests.			II, 1975 through II, 1976	
		4. Conducting laboratory investigation on choice of monomers and resins, conducting complex physical and mechanical investigations of specimens. Investigating, improving, and standardizing tests.			III, 1976 through II, 1978	
		5. Exchanging investigation methods for determining physical and mechanical properties of polymer-concretes, and discussions.			II, 1975 through II, 1977	
		6. Initiate research to develop new low cost systems and new uses such as desalting and geothermal applications.			II, 1975 through II, 1978	
		7. Development of recommendations for selecting monomers and synthetic resins and also catalysts and promoters of polymerization for concrete impregnation. Discussion of recommendations.			III, 1976 through IV, 1978	